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AGRICULTURAL RESEARCH ADMINISTRATION Service
BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

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# TITLE

WORK PROJECT ANNUAL REPORT

YEAR ENDING DECEMBER 31, 1953

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Forest Insect Laboratory
Coeur d'Alene, Idaho

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WORK PROJECT ANNUAL REPORT

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Administration
Bureau of Entomology and Plant Quarantine
Division of Forest Insect Investigations

Station: Coeur d'Alene, Idaho Period: Calendar Year 1953

Leader: James C. Evenden

(Report Prepared by Philip C. Johnson, Asst. Leader)

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Work Project I-c-1

UNITED STATES DEPARTMENT OF AGRICULTURE

WORK PROJECT ANNUAL REPORT -- YEAR ENDING DECEMBER 31, 1953

Bureau: Entomology & Plant Quarantine Division: Forest Insect Investigations

Work Project Title: Tree-Killing Bark Beetles

Summary of Progress:

Both the Ponderosa Pine Risk Rating System and the Ponderosa Pine (Keen) Tree Classification have been successful in measuring the degree of current and long-term susceptibility of individual pine trees, respectively, to attack by the western pine beetle (Dendroctonus brevicomis Lec.) in the Pacific Coast States. The rating system and tree classification aid in the selection of trees most likely to be attacked by the beetles. The removal of these trees in pine harvest cuttings of varying intensities has resulted in eliminating current beetle outbreaks and beetle proofing commercially valuable residual stands for varying periods of time. Because the rating system and tree classification have been so outstandingly successful as an adjunct to beetle control in California, Oregon, and Washington, there has been a desire by foresters and lumbermen to use them for a similar purpose in the merchantable ponderosa pine stands of the northern Rocky Mountains. Their effectiveness in this region is unknown, however studies now under way by the laboratory aim to establish this.

By the end of 1952 a total of 17 ten-acre study plots had been established in a number of operable ponderosa pine stands in western Montana. The 4,240 pine trees (containing 2,756,700 board feet) 12 inches or over on the plots were tagged, measured for board-foot volume, risk rated, and classified according to their beetle susceptibility. In 1953 the trees were re-rated using the penalty scoring system[1/] developed for use with the tree classification as a means of placing the study on a comparable basis with similar

1/ The penalty system is employed in connection with the Ponderosa Pine (Keen) Tree Classification. Its purpose is to rate tree health and risk to bark beetle attack by accumulating arithmetic penalties for individual symptoms of unhealthy crown, needles, weakness and injury.

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studies in California and Oregon. Trees killed by the beetle were recorded.

The evaluation of the risk rating system and the tree classification will be determined by the number of trees killed in each rating or classification during the life of the study. The study has not progressed far enough to furnish any indication of the beetles' preference for the more susceptible trees of the rating system or tree classification. (I-c-1-1).

In recent years several large tracts of Federal and privately-owned ponderosa pine timber in western Montana have been subjected to sanitation-salvage type pine harvest cuttings as a means of controlling or preventing outbreaks of the western pine beetle. The cuttings removed from the stands trees most susceptible to beetle attack, as determined by the application of the ponderosa pine risk rating system. Subsequent beetle-caused tree mortality is being measured each year and compared to that from comparable uncut stands. Insufficient time has elapsed since these measurements were begun to determine whether the cuttings have been successful in reducing beetle-caused pine tree mortality in the cutover areas. (I-c-1-2)

The devastating outbreak of the Engelmann spruce beetle (Dendroctonus engelmanni Hopk.) in spruce forests of northeastern Washington, northern Idaho, and western Montana has resulted in the killing of 2,684,000 sawlog-size trees with a volume of 1,821,700,000 board feet since its discovery in June 1952. Large-scale beetle control operations inaugurated in July 1952 have been seriously hampered by an inadequate knowledge of the biology and habits of the beetle in the region of infested forests. Biological studies were conducted on a limited basis in 1952 and increased in 1953 as funds permitted. The studies were essentially of a cursory nature -- aimed at providing some knowledge of essential life history and habits in the shortest possible time in order to effect more efficient use of control funds.

Field studies in 1953 support the following observations:

1) The origin of beetle populations initiating the outbreak in 1952 was from populations bred in windfelled spruce uprooted in November 1949 and the spring of 1950.

2) The beetle in 1952 and 1953 attacked trees indiscriminately, mostly in groups some of which comprised all the trees in some drainages.

3) Many trees were attacked in a manner which assured their death in a matter of a few weeks, some trees were partially attacked causing only parts of trees to die, and some trees successfully resisted attacks of the beetle.

4) The beetle attacked primarily the lower- and mid-bole portions of trees.

5) The number of attacks per square foot of bole bark surface were more numerous at the base of infested trees and progressively fewer toward the tops.

6) Woodpeckers feeding upon beetles, beetle larvae, and pupae, have destroyed as much as 80 per cent of the total developing beetle population in individual infested trees.

7) In general, the beetle requires two years to complete its life cycle at elevations of 5,000 feet or above and one year at 3,000 feet or below.

8) Casual examinations of developing broods often do not help to fix the time of attack of some individual trees because of the many brood stages present which resulted from variations in the life cycle length and from successive attacks of parent beetles.

9) The major attack period of the beetle generally is confined to the months of May, June, and July.

10) Newly attacked trees are best detected by boring dust in the bark crevices at the base.

11) Certain beetle developmental characteristics made known by previous studies in Colorado were substantiated. (I-c-1-8, revised)

Studies were begun in Montana in 1953 to test the possibilities of using freshly felled green spruce trees to draw attacks of the Engelmann spruce beetle away from nearby standing trees. After they are attacked and prior to the emergence of the developed progeny beetles, the felled trees would either be removed from the woods and the beetle broods destroyed during the milling of the trees into lumber, or the tree bales would be sprayed with bark penetrating insecticides. Either treatment would kill the progeny beetles before they emerged and attacked standing trees. The study of these "trap" trees was a continuation of a similar study conducted in Colorado in 1952 and was carried out under the direction of the Fort Collins, Colorado, laboratory.

The objectives of the 1953 Montana study were:

1) To substantiate the findings of the 1952 Colorado study which indicated a decided preference on the part of the beetle for freshly felled spruce trees.

2) To find the number of felled trap trees needed, and their distribution, to reduce the number of attacked standing trees in areas of varying infestation severity.

3) To determine the conditions of shade, direction of felling, size of tree, and other factors conducive to the maximum density of beetle attacks on felled trap trees.

During the late May and early June 689 green spruce trees were felled as traps on 606 acres in 11 separate areas within the general spruce beetle outbreak zone. Three additional areas were used as checks. In some areas the trees were cut in groups of 25 while in others they were scattered. In June and July a survey of 100 per cent of each of the 14 study areas was made to learn the number of trees attacked in 1952. It was expected that the beetles attacking the felled trap trees would be those emerging from these trees in June and July. After the general 1953 attack period was concluded early in August, another 100 per cent survey was made of the study areas to determine the number of 1953-attacked standing trees. Each survey required an average of 100 mandays.

Measurements taken from the felled trap trees in August and September included the number of beetle attacks per square foot of bole bark surface, infested bole bark area, height from the tree base and bole diameter at that point of the highest beetle attacks, the effect of sunlight and shade on the density of attacks.

One of the first indications of the results of the study was the ratio of the board-foot volume of trees killed in 1953 to that of trees killed in 1952 on the trap tree and check areas. In the 11 areas where trap trees were felled the ratio was 0.92 to 1, in the check areas where no traps were felled, 2.16 to 1. These results are subject to further analyses, but there is some indication that the use of the trap trees checked the increased killing of trees in 1953 to some extent in treated areas. (I-c-1-9, revised)

A test was begun in July of the comparative effectiveness of controlling outbreaks of the Douglas-fir beetle (Dendroctonus pseudotsugae Hopk.) by logging and milling infested trees and by spraying their boles with bark penetrating insecticides prior to the emergence of beetles bred in them. Cooperating in the study with the laboratory were the Coeur d'Alene National Forest timber management staff, the Division of Timber Management, Forest Service Region 1, and silviculturists of the Inland Empire Research Center, Northern Rocky Mountain Forest and Range Experiment Station.

Following an appraisal survey of several Douglas-fir beetle infested areas, three on the Coeur d'Alene National Forest were selected for the study. The areas, contiguous to each other, include a 500-acre check, an 1,100-acre area for chemical control treatment, and one of 860 acres set aside for control-by-logging treatment. Both treatments are directed against broods developed from attacks of the beetle in 1953.

In the chemical treatment area, an emulsion of ethylene dibromide was sprayed on the infested portions of the boles of approximately 1,100 felled 1953-attacked trees. After felling and before spraying, the trees were limbed and bucked into logs for ease in rolling so that all sides could be reached by the insecticide. Treating work was done by the Forest Service under the technical supervision of the laboratory. Hand spraying using pack train supplied Jeep cans and stirrup pumps later gave way to spraying which employed truck-mounted power pumps and tanks with radiating spray hose lines along a specially-constructed road. All treated trees were previously located and marked by Forest Service spotting crews.

Similar spotting crews also marked the infested trees to be cut in the control-by-logging area. These, a small number of poor risk trees, about 150 green felled "trap" trees, and logging road right-of-way trees -- about 1,500 altogether -- will be logged in the spring of 1954 before the new adult beetles emerge. The logging will be conducted according to Forest Service timber sales procedure. The marking of the trees, the letting of cutting and road-building bids, and the initial construction of a road into the study area by the Forest Service were completed in the fall of 1953.

Results of the study, indicating the beetle-control effectiveness of each treatment, will be obtained in the fall of 1954 after the beetle has completed attacks for that year. During the early spring of 1954 forest experiment station silviculturists will classify each infested tree on the control-by-logging area according to the preliminary classification of tree vigor for western larch and Douglas-fir trees in western Montana developed by the Station in 1949. Other post-cutting silvicultural aspects will also be studied by these men. (I-c-1-11, revised)

## Recommendations Regarding Further Work

Field measurements and data analyses on the above line plots should be continued until significant conclusions can be drawn.

## List of Publications

(a) Publications appearing during current year:

Evenden, James C.
The year of the Engelmann spruce beetle in Idaho. The Idaho Forester, University of Idaho. 1953 Edition.

(b) Manuscripts approved for publication but not published:

None

(c) Papers read at meetings but not printed.

None

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Work Project I-c-6

UNITED STATES DEPARTMENT OF AGRICULTURE

WORK PROJECT ANNUAL REPORT -- YEAR ENDING DECEMBER 31, 1953

Bureau: Entomology & Plant Quarantine Division: Forest Insect Investigations

Work Project Title: Foliage-Feeding Insects Affecting Trees

Summary of Progress:

Early in the year progress on spruce budworm ecology studies conducted in 1952 was summarized in a special report which added to the knowledge on the timing of the breaking of hibernation by the budworm, the density of overwintering populations from varying infestation severities, and the relation of overwinter population density to subsequent tree defoliation.

Natural emergence of larvae from hibernation under bole and branch bark plates occurred in the northern Rocky Mountains on May 15 in 1951, May 1 in 1952, and June 1 in 1953. This point in the life cycle marks the beginning of tree bud and foliage damage caused by the larval feeding of the budworm.

It was demonstrated that larval emergence from hibernation could be simulated by laboratory rearing techniques several months in advance of the natural phenomenon. This offers new possibilities to timberland owners or managers in directing budworm control operations to areas where the greatest amount of budworm kill can be realized. Heretofore, control operations were located in areas where tree defoliation the year before was severe enough to threaten the life of the infested trees. In some cases, natural control factors suddenly diminished the overwintering population so that budworm control operations the following spring would have been useless. The forced emergence of hibernating populations now precludes this possibility by providing a dependable measure of the population almost up to the actual time of control.

The report also indicated that the severity of tree defoliation expected in any season can be predicted to a considerable degree by the density of the budworm population the preceding winter, as shown in the following tabulation:

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| Number of Larvae Per 100 Square Inches of Bark Surface | Estimated Percentage of Fir Defoliation |
|---|---|
| 0-5 | 0-15 |
| 5-10 | 15-35 |
| 10-15 | 35-50 |
| 15-20 | 50-65 |
| 20-25 | 65-70 |
| 25-30 | 70-75 |
| 30-35 | 75-80 |
| 35-45 | 80-85 |
| 45-55 | 85-90 |
| 55-70 | 90-95 |
| 70-85 | 95-100 |

(I-c-6-4)

Budworm control operations on 12,000 acres in the Bitterroot National Forest in July 1952 and on 135,000 acres in the Nezperce, Helena, and Deerlodge National Forests in July 1953 provided opportunities to test the application of overwintered population density information in control planning. Areas to be controlled in each of the operations was defined from budworm damage surveys the preceding autumn using the severity of tree defoliation as a criterion. Further refinements of control area boundaries were then made in May and June, only a few weeks from the start of operations. This was done by using budworm population density information obtained by the forced emergence in March and April of overwintering larvae from bark samples collected at various points throughout the general area of operations. Thus, it was possible to confine control treatment to specific areas where budworm populations were denser and where the greatest possible number of budworms could be killed with each control dollar. (I-c-6-5)

## Recommendations Regarding Further Work

Further substantiation of the results of present investigations is desirable. Additional work is needed on the epidemiology of budworm outbreaks in this region, on the improvement of guides that can be used in determining the need of control, and the silvicultural possibilities of regulating budworm outbreaks.

## List of Publications

(a) Publications appearing during current year:

Denton, Robert E.
The spruce budworm problem in the northern Rocky Mountains.
Northwest Science. May 1953.

List of Publications (Cont'd.)

(b) Manuscripts approved for publication but not published:

Denton, Robert E.
Midge damage affects Christmas tree production in the Inland Empire. Publication medium not determined.

(c) Papers read at meetings but not printed:

None.

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Work Project I-c-9

UNITED STATES DEPARTMENT OF AGRICULTURE

WORK PROJECT ANNUAL REPORT - YEAR ENDING DECEMBER 31, 1953

Bureau: Entomology & Plant Quarantine Division: Forest Insect Investigations

Work Project Title: Development of Methods for Conducting the Most Effective and Economical Forest Insect Surveys

Summary of Progress:

During the year modifications were made in accepted bark beetle damage survey techniques to fit them to the vastly increased survey program occasioned by the current Engelmann spruce beetle epidemic. Difficulties in observing outward signs of infested trees necessitated modifications in the size and number of cruise sampling strips, the difficulties and high cost of ground surveys were minimized by pre-survey aerial reconnaissance, and the overall magnitude of the regionwide 1953 appraisal of the course of the spruce beetle outbreak was reduced by the adoption of new infested area sampling methods.

Newly-infested Engelmann spruce trees are hard to find. The spruce beetle's presence in the tree is not evidenced by such easily seen signs as the fading foliage or copious pitch masses or flows on the trunks characteristic of the attacks of other bark beetles on other tree species. Instead, only a small amount of reddish boring dust is to be seen in the bark crevices around the base of the tree. The infested tree "spotters" on survey crews make tree-to-tree examinations looking for this dust and, to help them maintain their compass line and to increase their view of as much infested forested area each day, the width of their sample strips was reduced from 1 to 1/2 chain, or from 66 to 33 feet.

Survey crews were hampered by snow-blocked roads and many times by lack of roads, thus requiring long treks on snowshoes in difficult mountain terrain to reach infested spruce stands. Some crews were supplied complete camps dropped by parachute, one crew requiring three leap-frog camp drops and three days of snowshoeing to reach their work area. Oftentimes these

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spruce areas were found to contain little or no spruce timber or to be uninfested or entirely infested, situations not requiring detailed ground surveys. Pre-survey aerial reconnaissance of areas scheduled for spruce beetle ground surveys often disclosed such conditions and the crews were directed instead to areas comprising more profitable survey chances.

The location and severity of the spruce beetle outbreak was defined in 1952 by one of the largest bark beetle survey programs ever undertaken in this region. To keep abreast of the progress of the large-scale spruce beetle control operations now under way, an equally large survey program appeared imminent in 1953. Inasmuch as early summer detection surveys indicated that the outbreak was confined to the same areas it occupied in 1952, it was decided to save the expense and time of duplicating the 1952 surveys by capitalizing upon the wealth of data obtained by those surveys. Hense was developed the "ratio" survey for the 1953 program, a time-saving method of estimating the amount of spruce killed in 1953. The ratio survey program involved the following steps:

1) An examination of 1953 detection survey results which showed no drastic changes in the location of the outbreak in 1953 over that in 1952.

2) A study of 1952 reconnaissance survey results to select areas of more severe infestation.

3) The tallying of 1952- and 1953-killed trees on meandering sample strips.

4) The expression of the ratio of 1952- to 1953-killed trees for each infested area.

5) The application of this ratio to the 1952 estimate of infested spruce to obtain an estimate of spruce killed in 1953 in each infested area.

Less sampling was required to derive estimates of 1953-killed spruce by the ratio method than by the reconnaissance surveys used in 1952. By using the ratio surveys no lost time was spent in marginal infestation areas and it was possible to estimate the amount of spruce killed by the beetle in 1953 over the same aggregate acreage and with the same degree of accuracy but with less expenditures in time, manpower, and money than in 1952.

Another innovation in 1953 was the operation of spring spruce beetle surveys. These were made necessary because of the need of the control program for specific information in some drainages prior to the emergence and flight of hibernating beetles in June. There were some advantages to these surveys. Infested trees are more easily detected because of the scaling of their bark by woodpeckers feeding upon the spruce beetle broods. Travel

on snowshoes is faster on the sample strips than in the summer and autumn when the spotter must literally fight his way through dense ground vegetation on the same strips. Daylight hours are greater thus allowing full day working hours. On areas receiving 100 per cent spotting coverage, advance laying of string lines to divide the area into strips to guide the spotters is unnecessary because the spotters can guide on their own tracks in the snow and thus prevent skipped or double spotting coverage.

The extremely costly transportation in spring surveys far overshadows these advantages, however. Deep snow or mud, slides, or uprooted trees block most roads. Many spruce areas are far removed from any roads or shelter sites. Crews must spend many more hours snowshoeing or walking to and from work areas, camps must be dropped from the air, and snow travelling vehicles of uncertain mechanical performance must be rented. Because of these it has been determined that, at present, spring spruce beetle surveys are not warranted unless their greater cost assures definite monetary savings in control operations or elsewhere. (I-c-9-1)

In June exploratory tests were made to find new and better uses of aircraft for surveys of the spruce beetle outbreak. Comparative flights of a 285 h. p. Curtiss-Wright airplane and a Bell helicopter were made over selected areas of infested spruce. The tests demonstrated that, with proficient aerial observers, it was possible to detect and delineate centers of spruce beetle damage by means of foliage discoloration or woodpecker feeding evidence visible on infested trees from low-flying aircraft. It was also shown that the severity of the infestation in specific areas could be classified as light, moderate, or heavy. In some instances, the percentage of stand infested could be estimated with reasonable accuracy.

Practical uses of these results were incorporated into the 1953 spruce beetle survey program. They were especially useful in mapping areas of spruce forests, directing the work of ground survey crews into known infested areas and away from non-spruce forest areas, or areas of spruce not infested or already 100 per cent infested, and, in some instances, in recommending control action without the need of costly ground surveys.

The airplane proved more adept for overall general use on the surveys than did the helicopter. The latter appeared to have flight characteristics which were superior for detailed examinations of relatively small areas, but inferior for efficient coverage of broad areas.

The use of airplanes for delineating the perimeter and severity of spruce budworm tree damage received further attention during the year. This was accomplished by coordinating aerial observation with the period of maximum tree foliage discoloration caused by the feeding of budworm larvae. Greatly increased efficient use of airplane flying time on spruce budworm aerial

surveys was realized by the advance preparation of Douglas- and white fir forest type maps from information supplied by the Northern Rocky Mountain Forest and Range Experiment Station. Flight courses were planned with pilots in advance of flying and much needless and costly flying to locate fir stands from the air was eliminated by being able to fly directly to fir areas shown on the type maps. (I-c-9-2)

Recommendations Regarding Further Work

Increasing survey manpower and transportation costs, greater insect control costs, and an increasing awareness by the general public and timberland owners of the economic importance of insect outbreaks, warrants constant effort to improve the efficiency of field survey methods and the accuracy of forest damage estimates based upon them.

List of Publications

(a) Publications appearing during current year:

None.

(b) Manuscripts approved for publication but not published:

None.

(c) Papers read at meetings but not printed:

None.

## LIST OF REPORTS, TALKS, AND OTHER RELEASES OF INFORMATION

The following list is in addition to the publications listed under the work project discussions:

Staff

Program of work, Coeur d'Alene Forest Insect Laboratory, Season of 1953. Laboratory report. March 6, 1953. (Mimeographed)

Denton, Robert E.

Special Report CdA-2. Studies of methods of improving the accuracy and general efficiency of spruce budworm surveys, 1952 progress report. April 2, 1953. (Mimeographed)

Evenden, James C.

Work project annual report, year ending December 31, 1953. Laboratory report. January 27, 1953. (Mimeographed)

The Engelmann spruce beetle outbreak. A talk presented at a meeting of the Northern Rocky Mountain Section, Society of American Foresters. Missoula, Montana. January 21, 1953.

The Engelmann spruce beetle outbreak. A talk presented to the Chamber of Commerce, Coeur d'Alene, Idaho. February 19, 1953.

Forest insects. A talk presented to foresters and logging camp superintendents of the Potlatch Forests, Inc., Lewiston, Idaho. February 21, 1953.

Repeat of above, Headquarters, Idaho, March 21, 1953.

The spruce budworm infestation in Montana. A talk presented to the Chamber of Commerce, Helena, Montana, April 2, 1953.

Same, Clancey Grange, Clancey, Montana. April 2, 1953.

Same, Boulder Grange, Boulder, Montana, April 3, 1953.

The Engelmann spruce beetle outbreak. Panel discussion member, Wood Products Clinic, Spokane, Washington. April 8, 1953

List of Reports, Talks, and Other Releases of Information (Cont'd.)

Evenden, James C. (Cont'd.)

Same, North Idaho Chamber of Commerce, Coeur d'Alene, Idaho, May 22, 195[illegible]

Johnson, Philip C.

Life history and habits of economically important forest insect pests. An illustrated lecture presented to the laboratory section of a class in Forest Entomology, University of Idaho, Moscow. January 20, 1953.

Life history and habits of economically important forest insect pests. An illustrated lecture presented to Potlatch Forests, Inc., woods foremen and forestry staff, Camp 44, Avery, Idaho. January 22, 1953.

Special Report CdA-1. An analysis of some annual radial increment variations in Engelmann spruce beetle-killed trees. February 26, 1953. (Mimeographed)

Principles and application of the ponderosa pine risk rating system. Classroom lecture and field demonstration, class in Forest Management, Montana State University, Missoula. April 16, 1953.

Important forest insect problems in the northern Rocky Mountains. An illustrated talk, Biology Club, Walla Walla College, College Place, Washington. April 29, 1953.

Taxonomic aspects of forest insect problems. Lecture, class in Systematic Entomology, Walla Walla College, College Place, Washington. April 29, 1953.

Line project I-c-1-1. Tree classification based upon susceptibility to pine beetle attack. 1953 program of work. Laboratory report. June 15, 1953. (Mimeographed)

Special Report CdA-3. Entomological phases of the 1952-53 Engelmann spruce beetle outbreak in the northern Rocky Mountains. November 16, 1953. (Mimeographed)

Terrell, Tom T.

Illustrated lecture on forest insect pests presented to Forest Service rangers and technical personnel. Powell Ranger Station, Lolo National Forest, Idaho. June 11, 1953.

Detection of insect outbreaks. An illustrated talk presented to Forest Service personnel, Powell Ranger Station, Lolo National Forest, Idaho. July 15-16, 1953.

List of Reports, Talks, and Other Releases of Information (Cont'd.)

Trostle, Galen C.

2 X 2-inch glass mounted color transparencies filed at the Coeur d'Alene forest insect laboratory. Laboratory report. April 1, 1953 (Mimeographed)